DOCUMENT RESUME

ED 262 409 CS 209 271

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|---|---|
| AUTHOR | Moore, Tony |
| TITLE | Children, Teachers and Computers. P.E.N. (Primary English Notes) 45. |
| INSTITUTION | Primary English Teaching Association, Rozelle (Australia). |
| PUB DATE | Jul 84 |
| NOTE | 9p. |
| AVAILABLE FROM | Primary English Teaching Association, P.O. Box 167, Rozelle, New South Wales 2039, Australia ($0.75, Australian currency). |
| PUB TYPE | Guides - Non-Classroom Use (055) -- Collected Works - Serials (022) |
| JOURNAL CIT | Primary English Notes (P.E.N.); n45 Jul 1984 |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | *Computer Assisted Instruction; Computer Literacy; Courseware; Databases; *Definitions; Educational Games; Elementary Education; Evaluation Criteria; *Language Arts; *Microcomputers; Word Processing |
| IDENTIFIERS | *Computer Uses in Education; Software Evaluation |

ABSTRACT

The purpose of this focused newsletter is to give teachers who know little or nothing of computers some background on which to base further investigation and decisions. It begins by explaining what a computer is and defining such terms as software, hardware, memory, input/output devices, and disk drive. The newsletter then outlines four major uses for computers in schools: (1) in administration, (2) in computer literacy and computer studies, (3) in computer assisted learning (drill and practice, tutorial programs, curriculum oriented games, simulations, and logic and problem solving games), and (4) as a tool for word processing, data bases, programing with Logo, and creating word puzzles. As a supplement to the newsletter, a checklist of criteria for the selection and evaluation of software is included. (HOD)

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# Children, Teachers and Computers

Tony Moore

PETA

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P.E.N.
Primary English Notes ... from the Primary English Teaching Association
PETA

# Children, Teachers and Computers

## ABOUT COMPUTERS

- Computers are a fact of modern life — they are here to stay. They are not a fad to be ignored — they won't go away.
- Micro-computers are as familiar as television and radio sets in many Australian homes.
- As a result, thousands of children are already computer-literate.
- Computers have a useful role to play in our schools.
- There is an obvious need for all teachers to become aware of computers — their nature, use and potential.

## THE CONCERNS OF THIS P.E.N. ARE THAT . . .

- rational, well-informed decisions be made by all involved in the introduction of computers to the classroom, especially teachers;
- teachers continue to apply their express and intuitive knowledge of how children learn to the issue of children learning with computers and not be lured by technology back to outmoded and discredited learning theories.

**"Teachers must take what they already know about teaching and learn how computers can eventually make a difference to their students."**
Dan Watts **(Popular Computing).**

## ABOUT THIS P.E.N.

This P.E.N. has been written not by a computer expert but a teacher who is, himself, still in the process of learning about computers. His hope is that it will remove some of the mystery presently surrounding computers, and answer some of the questions which commonly concern beginners.

## THE ARGUMENTS OF THIS P.E.N. ARE THAT . . .

- The computer is a tool which has the potential to improve children's learning, a tool which, like any other, can be used badly or well.
- Children must learn about technology actively as they grow up into a technological age.
- The interaction between children in groups around a computer screen leads to much more productive learning than a single child's one-to-one relationship with it.
- Behavioural learning theories have as much value in computer programs as they have anywhere else.

## THE PLEA OF THIS P.E.N. IS THAT . . .

- teachers make only valid decisions about computers, their use and the programs to be run on them — valid because the teachers are well-read and well-informed and have carefully considered **why** the use of the computer will improve the learning taking place in the classroom.

## THE AIM OF THIS P.E.N. IS TO . . .

- give teachers who know little or nothing of computers some *background* on which to base *further* investigation and decisions.

# WHAT IS A COMPUTER?

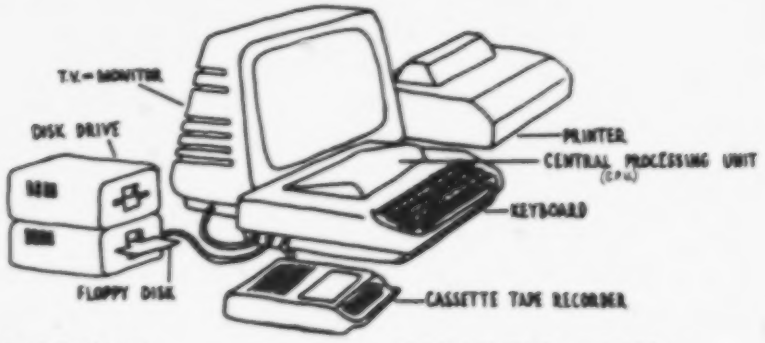
- "A computer is a machine designed as a general-purpose aid to problem solving." *Parent's Guide to Computers in Education*
- "A computer is an electronic device that manipulates symbolic information according to a list of precise (and limited) instructions to perform a few very simple operations." *Practical Guide to Computers in Education*
- The computer is a machine and, despite H.G. Wells and George Orwell, it should not be anthropomorphised into *Big Brother* or any other vast conspiracy.
- Using a computer through "hands-on experience" is the best way for the beginner to dispel fears and misconceptions.
- The computer is a machine which can manipulate information.
- The machine now being used in schools and homes is a **microcomputer.** This is a computer whose **central processing unit** comprises a single chip (see below).
- The computer itself is part of a **computer system** which consists of **hardware** and **software.**

**HARDWARE:** These are various mechanical devices which can:

- enter information into the computer for processing (INPUT devices);
- display or use the processed information (OUTPUT devices);
- store the processed information for future use (external MEMORY).

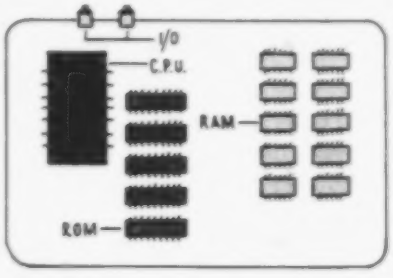
**SOFTWARE:** These are the programmed sets of instructions which adapt the computer's processing capabilities to an enormous variety of functions.

A very simplistic analogy can be made between a computer system and the cassette-tape sound system with which we are all familiar. The cassette player itself has a simple drive system and magnetic reading heads. Using a variety of cassettes *(software)* it can produce a variety of outputs, from grand opera to hard rock, from a baby's first words to the speeches of great orators and **it can even contain a series of unintelligible electronic bleeps which can make a computer run a program.** Output can be through mini-speakers, vast amplifiers and speakers and even through millions of radios.




## HARDWARE

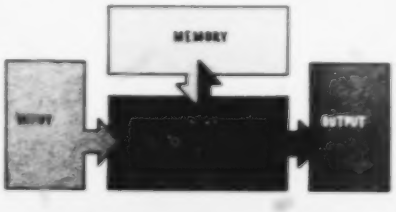
Under the lid of the computer there are basically four parts, although on many computers much extra is built in, and there are certainly many variations.




You will notice a number of squares, each of which is a small plug-in piece of silicon which contains the electronics of the computer's operation in thousands of microscopic components. Don Clark describes this as "a world in a grain of sand" *Exploring English With Microcomputers*

**CENTRAL PROCESSING UNIT (CPU)**

The largest block is the **central processing unit,** the computer's core. This is that central part of the computer that controls all the manipulations mentioned above. By definition, a microprocessor is one which has its CPU contained in a single chip. It is the CPU that decodes and then carries out the simple instructions it is given. It may have anywhere between 60 and 300 operations that it can perform. Its obvious value is that it can carry out these operations amazingly fast.




**MEMORY (ROM and RAM)**

There are two spaces on the computer board for holding information for processing. These are the groups of chips shown as **ROM** *(Read Only Memory)* and **RAM** *(Random Access Memory).* It is the size of the memory which defines the size of the computer, e.g. 16K or 64K etc. of memory (K as a measure = 1024 or 2 raised to the power of 10). These are the number of items (letters, numbers, spaces etc.) which can be held at any one time in the computer's memory.

*ROM (Read Only Memory)* is built into the machine and, generally speaking, is fixed and permanent. It remains in the machine, even when the power is turned off. In a sense, it is the computer's reference book. The CPU can draw on the information it contains but it cannot change it.

*RAM (Random Access Memory)* is the computer's working space. When we put information into the computer via the **keyboard** or by **loading** a program or through any other input device then the information is lodged in the RAM chips. When we turn the computer off the RAM is emptied. Therefore the only way to retain information that is contained in RAM is to **save** it onto some external memory device (see below). This is the reason why computer users constantly save their work in progress — power failures can always occur. On many computers there is provision for the RAM to be increased at a future time and this may well be a consideration when choosing which one to purchase.

**INPUT/OUTPUT (I/O)**

These are the connection spaces for external or peripheral devices, e.g. video screen, external memory storage, printers etc. It is also important for purchasers to be aware that connections, leads etc. between these devices and the computer may be complex, expensive and unique, so check carefully before you buy.

**EXTERNAL MEMORY**

Information which is processed in the computer can be loaded into the computer or saved from it in a variety of external memory devices.

The two which will most commonly be used in schools are ordinary good-quality magnetic recording **cassettes** or magnetic **disks.**

Cassettes are cheaper but slower, with far less capacity. Disks are more expensive but much faster and have much greater storage capacity.

The **disk drive** which loads the information from, or saves the information to, the disk may well cost as much as the computer. On the other hand, a disk costing $3 or $4 may well hold all of a child's writing for the year if word-processing is part of computer use in the classroom. It is the cassette player or the disk drive which is used to load commercial or other pre-written programs into the computer and to save and store any information from RAM on blank cassettes or disks.

**INPUT/OUTPUT DEVICES**

**(Peripherals)** The most recognisable of the input devices to the computer is the standard QWERTY typewriter keyboard with some extra keys added to perform specific functions. The most common output device is the **video display terminal,** often an ordinary TV set.

There are also many other devices which may have relevance for classroom use, e.g.

- printers
- plotters, which can graph and draw
- voice and music synthesisers
- mechanical robots
- graphics tablet: the user draws on a pad, the drawing is transferred to the screen, held in memory, varied, squashed, changed, coloured, printed out on paper
- telephone connections, which allow computers to communicate with each other, giving the school of the future possible access to unlimited data

The list of such devices is long and growing.

## SOFTWARE

Decisions concerning the choice of software packages (the programs) to be run on the classroom computer/s are crucial to the value of computers in education. Essentially, a program is a logical step-by-step set of instructions which tells the CPU to undertake certain operations in a certain order with various pieces of information. Programs are commercially made or can be created by the user skilled in programming.

There are three important points to note:

1. The creation of good software is very difficult and very time-consuming.
2. Software made for one brand of computer will probably not run on another.
3. There is a lack of good software available now for classrooms, while there are many programs which are educationally unsound, being based on outmoded learning theories and dubious teaching practices.

# COMPUTERS IN THE SCHOOL

Generally, there are four major uses for computers in schools:

- Administration — the computer as a management tool.
- Computer literacy and computer studies — the computer as an object of study, in itself.
- Computer-assisted learning — the computer as teacher.
- The computer as a tool.

## 1. ADMINISTRATION

The front office may well obtain one of the school's computers (or indeed the only school computer) and use it for school records, reports, central register of marks, standardised letters etc. *A Parent's Guide to Computers in Education* (see Bibliography) discusses many of the pitfalls of this practice. The computer is certainly of little educational benefit to pupils while restricted to the front office. This area is **not** the subject of this PEN.

## 2. COMPUTER LITERACY AND COMPUTER STUDIES

Such studies are not really the subject of this PEN either. Many of the issues in computer literacy are discussed in the PETA/ETA discussion paper *Computers in English Teaching* (see Bibliography). An excellent summary of this position is given by Dan Watts:

*When we talk about computer literacy or information literacy, then, not only are we talking about formal courses, but we're also talking about a technologically literate culture for children to grow up in. If schools are to play an important role in creating that culture, teachers must become literate themselves. Preparing teachers involves training not only those teachers who will teach specialised computer courses — the "English teachers" of the computer-literate society — but preparing all teachers to provide a culture of literacy.* **Popular Computing.**

Children become literate by actively engaging in reading, writing, speaking and listening; they become computer literate by actively using computers for real purposes, not in dummy-run exercises.

The specialised study of specific aspects of computers, eg **programming** is also not part of this PEN.

## 3. COMPUTER ASSISTED LEARNING (CAL)

Computer as teacher:

*For most people, using computers for instruction in the classroom is synonymous with computer-assisted instruction. Programs to drill students or to examine student response and provide appropriate feedback are the most easily conceived applications of computers for classroom use. Most research on computers in education has centred around CAL curricula and delivery systems and most products marketed for educator-consumers have been CAL products.* H.J. Becker. **Microcomputers in the Classroom; dreams and realities.**

Science fiction writer Arthur C. Clarke says that any teacher who can be replaced by a computer **should** be. Computers will have useful roles in the classroom but must not be allowed to take over the teacher's role. It is even easier to hand over teaching responsibility to a computer than to a textbook or kit. Computers should be used to **enhance** the teacher's role, not usurp it.

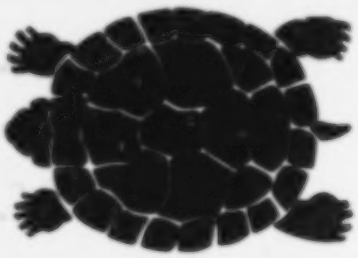
Adeline Naiman lists the following five categories of CAL:

### (a) Drill and practice:

Computers are very good at behavioural teaching. Repetitious drilling and the teaching of skills and facts extraneous to context can be done in a more individualised and

The topics for such data bases are, of course, unlimited. Creating a data base takes pupils through all elements of the writing process to a quite different product. Creating a data base is also an important part of computer literacy — it is a key way to see how the world's information is stored, structured and retrieved.

**"As agents of change in society, computers cannot be ignored. This alone is an urgent and compelling reason why education systems should work to ensure that young people gain computer awareness."** Ron Mulock, NSW Minister for Education.



## (c) Logo

*Logo* is a programming language for children, designed by Prof. Seymour Papert and colleagues at the Massachusetts Institute of Technology. Papert, a former colleague of Jean Piaget, believes that as children teach so they learn and that, through programming or "teaching" a computer with *Logo*, even very young children develop extended concepts and ways of thinking.

Papert's book "*Mindstorms: children, computers and powerful ideas* is essential reading for all interested in children's learning and computers. One of Papert's ideas is that children can achieve higher levels of abstraction in thinking by using the concreteness of the computer screen. He believes that Piaget's views are correct, but only in a cultural context. The computer, he argues, extends that culture and thereby extends what children are capable of doing.

*Logo* has been designed for primary school children. The feature of it is that children can produce quite amazing and satisfying screen designs in a very short time and be led on to quite purposeful activities in programming.

It is important that teachers understand the conceptual development that underlies these further activities:

> *Logo can be a powerful aid to learning. But not without the help of a knowledgeable teacher and suitable curriculum materials. Logo, by itself, will do little for most students. It is not a teacher-proof educational tool. Most teachers require a substantial amount of computer education and experience to even begin to help their students to realize the potential of a Logo computer system. I believe in the potential of Logo but I believe much more strongly in the part educators will play in its effective use.* David Moursand, **The Computing Teacher**, Vol. 11, No 5, p 4.

Classes in which *Logo* is effectively used become exciting places chacterised by argument, surmising, activity, creativity and inquisitiveness.

## (d) Crosswords etc.

The last group of programs to be discussed in this section are those that provide for the professional creation of crossword puzzles, "worder" puzzles, etc. They presently tend to be used by teachers to produce good quality puzzles for pupils to do. They would be far more effective if, as in the case of data bases, the children do the creating themselves.

In a program such as *Crossword Magic* children can write answers and clues (from any subject area) and the program will print out the unfilled crossword matrix and clues in the same format as children would see in a newspaper, together with a separately printed answer form. Children soon discover any shortcomings in clues and are made aware of the need for detail and exactness. Because of the need for detailed information, they also tend to research their material more fully to obtain tricky and precise clues.

# FINALLY . . .

Nothing is more inevitable than the introduction of computers into education. Like all of man's innovations, it has its positive and negative side, its uses and misuses. Sound decisions about the use of computers in schools should be based on reliable and, where possible, comprehensive information. It is hoped that, for many teachers, this PEN will be a useful start.

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*Obtainable from NSW Computer Education Group, C/- Joint Council, Rozelle Public School, Rozelle NSW 2039.

This P.E.N. should be read in conjunction with the PETA/ETA discussion paper **Computers in English Teaching** (1983).

**N.B. We have avoided recommending specific programs in this PEN, in the belief that the beginner will learn more by making his or her own discoveries.**

**Tony Moore**


P.E.N. 45 (July 1984) was written by **Tony Moore**, who is English Master at Casula High School (NSW). He wishes to acknowledge the assistance of John Treloar, Computer Consultant, Liverpool Region.

PENs are edited by **Walter McVitty** and published six times a year by the Primary English Teaching Association, P.O. Box 167, Rozelle, NSW 2039, telephone (02) 818 2591.

motivational way with more instant feedback to the student than the most hardworking teacher can provide. The workbook format is also one of the easiest forms of program to write. Publishers therefore have them in the hundreds DO NOT consider these remarks as an endorsement of these teaching methods, but merely a statement of what exists and what constitutes the bulk of programs being offered to teachers by the educational computer publishers. An excellent even-handed critique of drill-and-practice programs is contained in *Microcomputers in the Classroom: dreams and realities*, pp.17-25.

## (b) Tutorial programs.

These programs are an extension of mere drill and practice, as they also provide more feedback to the learner on errors, patterns of response, hints, examples etc. Some aspects of these have been incorporated into interactive writing programs, which are discussed below in relation to word-processing. These programs do give the learner in varying degrees, more control than do drill and practice programs. In *Computers and Communication*, J.S. Brown has listed four problems in trying to write effective tutorial programs.

- *A practical theory of hints.* Suppose a student has no idea how to solve a problem. What information should the computer provide?
- *An algorithm of hints* that make them a function of skills an individual student has mastered and those he has not. Suppose the student solves part of the problem but gets stuck.
- *A theory of interference.* Suppose a student begins to make errors while solving a problem. Should the computer stop the student as soon as the error is made, or at what further point?
- *Appropriate limitations on computer intelligence.* Intermediate steps of a student's solution may not necessarily be provided to the computer. Yet an intelligent tutor may be able to deduce the intermediate step which caused the error. Should the computer be provided with the same kind of skills?

Each of these will be considerations in using particular tutorial programs in a classroom. Each of them also indicates the value of a partnership, where the *computer* can allow the *teacher* time to cope with the errors with which the computer *tutorial program* cannot cope. To be effective, such programs, beyond those teaching fairly straight-forward skills, must be very complex and that requires detailed programming and machines with fairly large memory on which to run. Another important factor to consider is the context in which the program is set. There are a number of tutorial programs available to teach keyboard skills. Like handwriting, keyboard skills might better be taught in the context of a real use of the computer rather than as an end in itself.

## (c) Curriculum Oriented Games.

These are games in which success is based on previous learning. They are played either against the computer or other players. They include *Space invader* games based on maths algorithms, *Hangman*-type spelling games, *Battleships*, based on a knowledge of co-ordinate geometry and plotting. *Scrabble* for the computer is also available. These games have a high motivation value, are fun and are an effective use of the computer in the classroom.

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**"Schools, as part of the society in which we live, must also reflect computer and other technologies in the ways in which students learn and in the content of what is taught. We cannot prepare students for life in the 21st century without preparing our schools first".** Doug Swan, NSW Director-General of Education.

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## (d) Simulations.

The British Council has defined a simulation as "An activity in which students discuss a problem which is in a setting that has been clearly described to them. Students apply their own knowledge and experience to this information, thus giving them the basic data to discuss the problem". (Quoted in *Exploring English with Microcomputers*)

Simulations take the use of the computer into an area which is not merely teacher-substitute. Effective simulations can develop clear thinking, decision making, an awareness of consequences, co-operative discovery and organisation. Simulations allow children, especially in groups, to run, control, assess, monitor and deal, for example, with crises in a nuclear power plant (*Three Mile Island*); making business decisions in running a street stall (*Lemonade*); pilot a rocket ship to land in space (and, in the course, develop a knowledge of Newton's laws of motion); use initiative and alternatives and lateral thinking to escape from a pseudo South American goal; solve a murder; engage in role plays etc.

The future may well bring effective role playing in the context of literature, e.g. children might write extensions and variations which can be tested against a given plot's own limitations or logic.

The following was written by Jan Stewart, after observing a group of 11-year-olds involved in a simulation game in which the object was to find a hidden treasure map.

> *Most teachers are aware that real thinking may be more readily provoked in their pupils when they pose genuine problems to a class rather than questions with a particular answer — the open-ended rather than the closed approach. Nevertheless, the demand such an approach has on the personal insecurity and discipline skills of teachers tends to restrict its use to only the talented or reckless members of the profession.*
>
> *When problems such as the finding of a lost map are posed by a microcomputer the situation often changes — particularly for the teacher. Rather than feeling threatened, he or she joins the children as a participant, an observer or both. . . as the structure of a program is realised through experience and rules are developed, pupils and teachers have the satisfaction of developing the most efficient strategies for their solutions to problems posed. Rather than inhibiting oral language, therefore, the use of a computer can encourage it.*
>
> **Exploring English with Microcomputers.**

These programs have enormous potential for further writing and investigation by children. In this role, the computer can be an all-purpose aid to problem-solving and learning and an integral part of the discovery/growth model of learning not available through other media.

## (e) Logic and Problem-Solving Games.

Many well-known games which involve logical thinking (e.g. draughts, chess, *Othello*, *Mastermind*) have been built into computer programs.

Individuals or groups can play against the computer at different levels of difficulty, in a challenge which develops capacity for deeper thinking. Model building games are an extension of these: the player is supplied with only part of the rules and has to determine both rules and strategies.

In US Congressional hearings in 1980 Dr J.C. Licklider (M.I.T.) pointed out that information technology had not made a major impact on education because the basic philosophy had been incorrect — computers had been used to "*push facts into students*". He believes that the approach which works best is

"*to use the computer to create a stimulating learning environment and to make the computer a partner to the student in exploring and in solving problems*"

## 4. THE COMPUTER AS TOOL

In using the computer as tool the child begins to drive the computer instead of the computer driving the child. There are a number of uses of the computer as a tool, four of which are discussed here. These are (a) word processing, (b) data bases, (c) *Logo*, (d) *Crossword Magic* and word puzzle creators.

### (a) Word Processing

Word processors have been used for some years in many offices, but programs have now been developed which convert microcomputers into quite complex word processors and text editors. These programs give the user the facility of typing and then "cutting and pasting" (re-arranging) letters, words and paragraphs on the video screen, completely formatting a text before printing it out. All of this work is done by very simple single or double key commands.

Research on the value of word processing and writing in classrooms is limited at the moment. There is strong evidence of many children's increased willingness to edit on the screen, but whether there is an increased willingness to edit text and information as opposed to attending to spelling, punctuation and simple aspects of syntax is not yet clear. It does, however, provide an attractive option for those children who find writing tedious and are reluctant to edit their work for fear of rewriting. Many professional writers are enthusiastic users of word processors, while others say they only "think through their pencil", working directly onto paper.

If word processors are to play a part in the classroom, it is important that children are shown the full value of composing on them rather than merely using them as editors. Brainstorming, setting out headings, throwing alternate phrases onto the screen (long before the first draft) are valuable and effective uses of the program. Children should also be encouraged to indulge in writing splurges, free in the knowledge that editing is so much easier.

One program designed for children and widely used now in Australian classrooms is the *Bank Street Writer*, (Ashton Scholastic) which requires a whole change of mode to shift from composing to editing. As a result, it encourages children to think in terms of units of composing, then editing, rather than going backwards and forwards to correct individual letters or words etc. while composing.

Many programs are now being incorporated into simple word processors for classrooms. A thesaurus can be built in so that, in the middle of composing, a child can type a command or give a word and be supplied with a variety of options. *Story Maker* allows children to explore alternative story structures. Other programs are simulations deliberately designed as pre-writing exercises. Spelling-checkers are available which will highlight and/or correct non-standard spelling (although the latter has obvious dangers).

An interesting group of programs being developed in the US and Canada allow the computer (as "conferencer") to interact with the writer by asking questions about the accuracy or appropriateness of what is being written. Such programs force the writer to pay close attention to detail. These programs are based on the assumption that effective questioning need not entail detailed knowledge of subject matter; it is the writer who must demonstrate this knowledge. There is much debate about the effectiveness of such programs, and the degree of intervention involved.

There are even programs designed to help in the composition of poetry! Stephen Marcus has developed *Comupoem* (University of California) to generate "poetic" ideas and phrases. Edmund Skellings has developed *Electric Poet* (Florida International University), which uses the computer as a "poetic" medium in itself, with its ability to handle, on the screen, words, sound, colour and change in a dynamic way.

Future development of computers for such creativity will be interesting.

### (b) Data Bases

Data Bases are, in a sense, electronic encyclopaedias with extremely fast automatic indexes. As such, they have enormous value as sources of up-to-date information. This PEN has already mentioned possible access to the world's data bases in the future. A very useful Australian data base already available is *First Fleet*, (Tasmanian Education Dept.) which gives access to information about all convicts transported in the First Fleet, including such details as names, ages, crimes and family backgrounds. For example, a student can discover which convicts had the surname Smith, or were over 60 years of age, or who had been transported for stealing items valued at, say, less than twenty shillings.

A more creative form of data base, however, is the pupil-created data base. Programs are available which allow pupils to design the format into which their own data is to be placed and then to enter their data into a useful data base. This form of creativity requires classification, indexing and organisational skills; again, co-operative action is involved. In classes where these programs are used there is a greater willingness for pupils to engage in further research to discover more information and to classify it in greater detail, so that the data base works more effectively.

Supplement to P E N. 45 *Children, Teachers and Computers*

# EVALUATION OF SOFTWARE
## A CHECKLIST FOR TEACHERS

The following criteria for selection and evaluation of software are based on those given in *Practical Guide to Computers in Education*, by Peter Coburn *et al* (addison-Wesley).

### PROGRAM CONTENT

- ☐ Is the content of the materials suitable for your students?
- ☐ Does the content of the materials fit with your curricular goals?
- ☐ What values does the content convey?
- ☐ Is the content educationally significant?
- ☐ Are the goals and objectives of the materials explicitly clear?

### PEDAGOGY

- ☐ What is the nature of the feedback the program provides to students?
- ☐ What assumptions about learning and how children learn are built into the software?
- ☐ Does the software permit modification to meet individual student needs?
- ☐ Can the program be used with various types of class arrangements (individual, small group, whole class)?
- ☐ Does the program tap a variety of learning modes (visual, aural, numerical, verbal)?

### PROGRAM OPERATION

- ☐ Is the program free of bugs and breaks (problems with the program itself)?
- ☐ How does the program handle user errors?
- ☐ How much control does the user have over the program operation?
- ☐ Are the directions in the program clear and acceptable?
- ☐ Is there good clear documentation for the teacher? (Most programs come with manuals or instructions.)
- ☐ Is there good clear documentation for the students?
- ☐ How well does the program use graphics, colour and sound capabilities?
- ☐ Are the screen displays effective?

### STUDENT OUTCOMES

- ☐ How easy is the program for students to use?
- ☐ Is the program interesting to students?
- ☐ Does the program make effective use of limited computer resources?
- ☐ Do students enjoy using the programs?
- ☐ How well do students learn what the program is intended to teach?
- ☐ What, if any, unintended learning results from using the program?
- ☐ How effective is the program compared with non-computer instruction in the same area?

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